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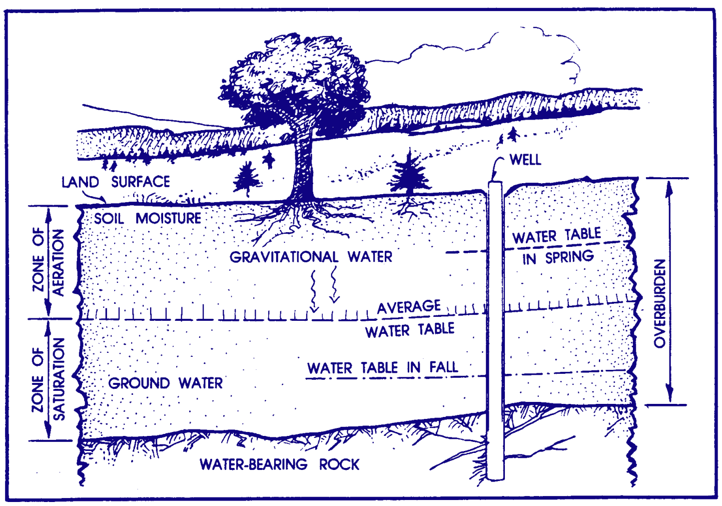
SAFE H2OME PROGRAM

What You Should Know About Ground Water and Aquifers

Maine has abundant ground water. In fact, plentiful ground water is a valuable resource for the people of Maine. Sixty percent of all Maine households get their drinking water from underground sources. Agriculture uses ground water for crop irrigation and livestock watering. Industries use ground water in food processing, mining, metal finishing, and other processes. Individuals and municipalities use ground water for drinking water and waste disposal, garden and lawn watering, and watering golf courses. Yet, for all its importance, ground water is poorly understood by many of the people who rely on it.

What is Ground Water?

<u>Ground water</u> is water found beneath the surface of the ground in fractures in bedrock and between the individual grains of sand and gravel deposits. The <u>zone of saturation</u> occurs where every space between rock and soil particles is filled with water. Above this saturated zone is an area in which both air and water are found in the spaces between soil and rock particles. This is called the <u>zone of aeration</u>, or unsaturated zone. Water moves downward through this aerated zone until it reaches the saturated zone. The <u>water table</u> is the top of the saturated zone.



Maine Geological Survey Diagram

The primary source of ground water is precipitation. Rain and melting snow soak into the ground and fill the pores between rock and soil particles. Geologists call this process <u>ground water recharge</u>, and the places where it occurs, <u>recharge areas</u>. Once it reaches the zone of saturation, ground water moves slowly by the force of gravity through the interconnecting pore spaces toward a <u>discharge area</u>, where it seeps or flows out into a wetland, spring, river, pond or to the ocean to become surface water.

Water returns to the atmosphere from surface water bodies (lakes, rivers, streams, etc.) and land surfaces through evaporation, and from plants by transpiration. Water in the atmosphere condenses into rain. Some of the rain recharges ground water, and the cycle continues. Ground water, in other words, is part of the hydrologic cycle. Ground water and

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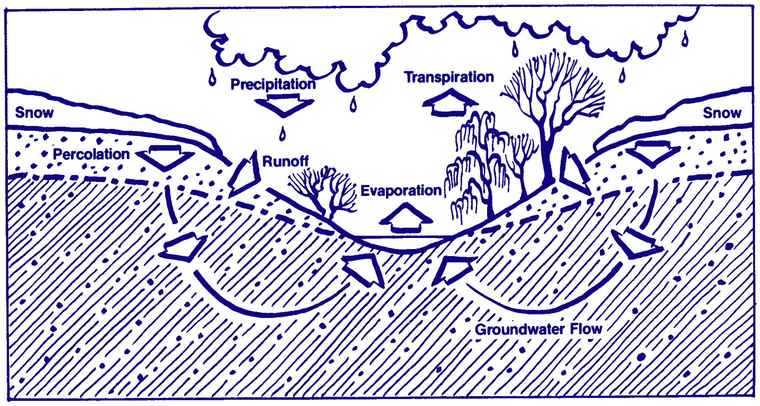
surface water are connected; ground water becomes surface water when it feeds into surface water bodies. Most streams keep flowing during the dry summer months because ground water feeds into them from the zone of saturation. However, under certain conditions the flow may be reversed, and the surface water may recharge the ground water.



Ground water recharge and discharge into a surface water body.

Ground water moves from higher elevation recharge areas to lower elevation discharge areas. This ground water flow is measured in feet per day, or, in some cases, feet per year. In contrast, surface water flow is measured in feet per second. In a ground water system like the one in the diagram, water that infiltrates the recharge area in April might travel only 300 feet by August or September. The speed at which ground water moves is determined by the material it must flow through and the steepness of the slope from recharge area to discharge area. Water moves more easily through the large pores of sand and gravel or an open, well-connected set of bedrock fractures than through the small pores of fine silt and clay or a narrow, poorly connected bedrock fracture.

The water table doesn't remain at one level all the time. The rise and fall of the water table occurs seasonally and is a natural part of the ground water system. In the late winter and early spring (March to May), ground water recharge from melting snow and rain raises the water table to its annual high level. During the growing season, rainwater is used by plants or it evaporates. As a result, little or no ground water recharge occurs during the late spring and summer months. During that time, however, ground water continues to seep into streams, lakes, and wetlands so the water table drops. By fall (September and October) the water table usually drops to its lowest annual level. Ground water is recharged again by rains that fall after the growing season. There is very little recharge in the winter when the ground is frozen. During the winter, water is stored in snow. In the spring, the melting snow recharges the ground water, raising the water table to its annual high level again.

Ignoring the natural fluctuation in ground water levels can result in costly problems. For example, foundations designed and built for ground water levels during a drought can be flooded when the water table returns to more usual levels.

Aquifers

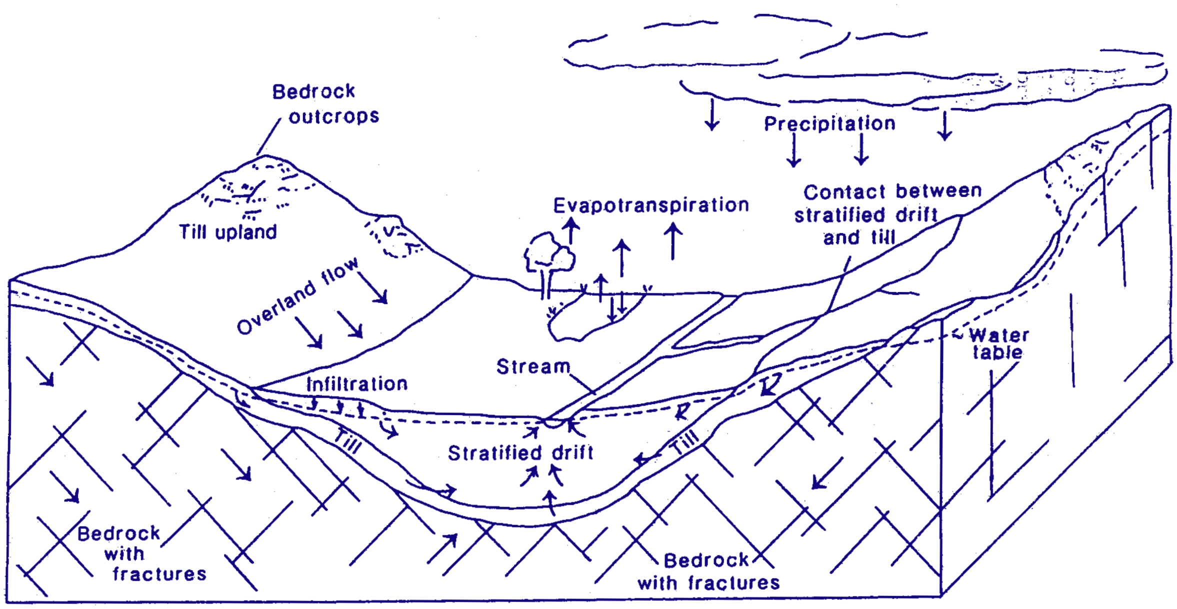
Although ground water can be found beneath all land surfaces in Maine, not all ground water can be drawn into wells. An aquifer is a geologic formation that is capable of yielding a useable amount of water to a well or spring. To yield amounts of water, wells should be located in aquifers. The amount of water a well will yield depends on the porosity and permeability of the formation it is in.

The amount of empty space between particles of material or in cracks of rock, called porosity, determines how much water it will hold — usually the more pores, the more water it will hold. Porosity is expressed as a percentage of the total volume of a material.

The ease or difficulty with which water flows through a material is controlled by the material's permeability. A material that is very permeable allows water to pass through easily. In contrast, it is hard for water to move through a slightly permeable material. Permeability is important because it determines whether ground water can actually be drawn into a pumping well. In bedrock, permeability depends on how well the fractures in the rock are connected with each other. Well-connected fractures will allow water to move easily; poorly-connected fractures will not. In a sand and gravel deposit, permeability depends on the size and connection of the pore spaces between the grains of material. Water moves quickly through large pore spaces and slowly through small spaces.

Porosity and permeability are related, but they are not the same thing. A material can be very porous and hold a large volume of water, but not permit the movement of water. For example, clay may be twice as porous as sand, but a pumping well will not be able to pull the water from the pores between the clay particles fast enough to supply the well. Very small pore spaces create a resistance to flow which reduces permeability. Porosity determines the capacity of a material to *hold* water. Permeability determines its ability to *yield* water.

Most people would call it soil, but geologists call the sand, gravel, soil, rock, and other



Cross-section of a typical Maine landscape.

loose material that lie on top of the bedrock surficial deposits or overburden. Most surficial deposits consist of a range of material types and sizes. In these deposits, almost all the spaces between the larger materials are filled with smaller particles.
For example, the spaces between pebbles and large stones are filled with sand, and the spaces between the grains of sand are filled with clay. This leaves few open spaces for ground water storage and makes it difficult for water to move through the pores. Thus, deposits that are a mixture of types and sizes of materials are not usually porous and perme-

able enough to serve as aquifers. In other surficial deposits, particles are similar in size and don't fit closely together. This creates many interconnecting pore spaces which can hold water. Some of these deposits are fine-grained silt and clay. They are porous but not permeable because the pores are too small to allow water to move easily. In some deposits of similar-sized particles, such as coarse sand, the pores are large and water can flow through them easily. Thus, these deposits are both porous and permeable and make excellent aquifers.

Bedrock, commonly called ledge, is the rock that lies beneath all the unconsolidated material (soil and loose rocks) on the surface of the earth. If a well intersects bedrock fractures that are filled with water, bedrock can serve as an aquifer. Most of Maine is underlain by highly fractured bedrock. Generally, fractures within the first 200 to 300 feet of the surface generally will supply enough water for private, home use. Some highly fractured zones can yield many thousands of gallons per day, and may be developed for municipal or industrial use.

Threats to Ground Water

There are many threats to ground water. Threats fall into two categories; threats to **water quantity** and threats to **water quality**.

The availability of water is reduced when more water is removed from an aquifer than is replaced through ground water recharge. This causes the water table to drop and may cause shallow wells to go dry. In coastal areas, excessive pumping may pull seawater into a well, thus making the well water unusable.

The threats to water quality come from many sources. In some areas, naturally occurring elements such as iron, manganese, arsenic, chloride, and radon can contaminate ground water. However, the most severe problems are caused by human actions. Pollutants can come from landfills, road salt storages, animal wastes, septic systems, underground petroleum storage tanks, and the misuse and disposal of industrial, agricultural, and home chemicals.

Contaminated ground water can have serious health and economic impacts on individuals and municipalities. Drinking contaminated ground water may cause significant health problems including nervous system disorders, kidney and liver disorders, and cancer. The costs of cleaning contaminated ground water can be staggering. In many cases, the water will not be usable again as a drinking water supply. In addition, property values in the affected area may fall sharply.

What Can I Do to Protect Ground Water Quality?

- Ask questions of local officials, such as planning board members, code enforcement officers, and licensed plumbing inspectors, about ground water quality impacts of septic systems, industries, and other activities in your town.

- Report spills or other problems with oil or gasoline to the DEP. The spill hotline number is 1-800-482-0777.

- If you have a well, test it every three to five years.

- If you have an abandoned well on your property, fill it in with concrete from bottom to top. **Clean fill** can be used to fill a dug well. An abandoned well should never be used for waste disposal as it is a path for contaminants to enter the aquifer.

- Underground storage tanks for gasoline or heating oil on your property should be registered with the Maine Department of Environmental Protection (DEP) and removed according to a DEP schedule if the tank is non-conforming (i.e. bare steel tank or piping). Replace these tanks with above-ground storage if at all possible. The Maine State Housing Authority has a program of low interest loans to assist homeowners with removal of underground home heating oil storage tanks.

- Take care of your septic system! Have the septic tank pumped every three to five years. Don't use septic tank cleaners as a substitue for a regular pumping schedule. Minimize the amount of grease you put down the system. NEVER use a septic system to dispose of household hazardous chemicals such as solvents, paint thinners, pesticides, gasoline, furniture polish, or antifreeze. Whenever possible, use biodegradable cleaning products.

- Work with local, state and federal governments to support the establishment of household hazardous waste clean-up days.

- Volunteer to assist the efforts of your local ground water protection committee, or start one if one doesn't exist in your town. Help local officials locate and protect local ground water supplies.

- Support ground water protection legislation and education at the local, state, and federal levels.